Salty Sea

Organizing Topic Investigating the Ocean Environment

Overview Students will investigate salinity.

Related Standards of Learning 5.6b

Objectives

The students should be able to

- explain key terminology related to the ocean environment;
- analyze how the physical characteristics (depth, salinity, and temperature) of the ocean affect where marine organisms can live.

Materials needed

- Salt
- Fresh water
- Large, clear plastic cups
- Food coloring
- Spoons
- Potato slices
- Ocean water
- Graduated cylinders
- Hand lenses, or microscopes
- Droppers
- Clean microscope slides
- Copies of the attached lab sheet

Instructional activity

Content/Teacher Notes

Different bodies of water can have different amounts of salt in solution — i.e., different *salinities*. Salinity of water is expressed as the number of grams of salt found in 1,000 grams of the water. Therefore, 1 gram of salt in 1,000 grams of water results in a salinity of 1 part per thousand (1 ppt).

Average salinity of ocean water is 35 ppt; however, rainfall, evaporation, river runoff, and ice formation cause this number to vary between 32 and 37 ppt. For example, the Black Sea is so diluted by freshwater river runoff, its average salinity is only 16 ppt.

The salinity of fresh water is usually less than 0.5 ppt. Water between 0.5 ppt and 17 ppt is called *brackish*. *Estuaries*, where fresh river water meets salty ocean water, are examples of brackish waters. The Chesapeake Bay is an excellent example of an estuary.

The salinity of water inside the bodies of most marine creatures is about the same as the salinity of the water in which they live because water seeks a balance. When an animal that normally lives in salt water is placed in fresh water, the fresh water flows into the animal through its skin. Conversely, when a freshwater animal is put into the salty ocean, the fresh water inside of it flows out. The process by which water flows through a semipermeable membrane, such as an animal's skin, from a solution of lower solute concentration (lower salinity) into a solution of higher solute concentration (higher salinity) is called *osmosis*.

Introduction

1. Ask the students whether they have ever wondered why the oceans are filled with salt water instead of fresh water. Just where did all that salt come from? Is it the same kind of salt you find in a salt shaker? Explain that most of the salt in the oceans came from land. Over millions of years, water flowing in rivers and streams has washed over rocks containing salt — the compound sodium chloride (NaCl) — and carried it into the seas. Some of the salt in the oceans comes from undersea volcanoes and hydrothermal vents. When water evaporates from the surface of the ocean, the salt is left behind. After millions of years, the oceans have become more and more salty — that is, their *salinity* has increased.

Procedure

Experiment 1

1. Have students work in pairs to fill each of 2 clear plastic cups less than half full with *the same amount* of fresh water. Have one partner mix 8 teaspoons of salt into the water in one of the cups while the other partner mixes a few drops of food coloring into the other cup. Emphasize that coloring the water with a little food color does not significantly change the salinity of the water: it is still fresh water. The color simply differentiates it from the salt water.
2. Now, have one partner hold a spoon directly over the salt water and the other pour the colored water very slowly into the spoon so that it slowly drips out into the salt water. Try to keep the spoon close to the salt water when pouring the colored water in order to reduce splashing and mixing of the waters. The students should note that the two different waters do not mix. If the colored fresh water is poured slowly enough, it will float on top of the salt water. Ask why. *(Salt water is heavier than fresh water, i.e., it has a greater* density.)
3. Have the partners very slowly and gently lower a potato slice into their water container without stirring the water. They should note that the slice sinks through the colored fresh water and floats on the salt water.
4. Discuss the results of the experiment with the class, leading them to draw correct conclusions about what happened. Include in the discussion the layering of waters due to their different salinities and thus different densities. Does this happen on a large scale in the ocean? Does the water near the bottom of the ocean have a greater density and salinity that that near the top? How might these differences in ocean water salinity in one geographical location affect the marine life that can live there?

Experiment 2

1. Give each student a copy of the attached lab sheet and an equal quantity of fresh water and ocean water. (If you cannot get ocean water, mix salt with fresh water and let it sit overnight.) Ask students to smell both samples and describe what they smell.
2. Have students use a graduated cylinder to determine the volume of each type of water.
3. Have students put a drop of fresh water on a clean microscope slide and observe it with a magnifying glass (or a microscope, if possible). Then, have them repeat this process to observe a drop of salt water.
4. Have students fan the two drops of water until the water evaporates. Have them predict what they will see when the water evaporates and then describe the actual result.

Observations and Conclusions

1. Have students complete the lab sheet and make observations.

2. Discuss with the class the salinity of ocean water, including the normal salinity, unusual salinities, estuaries, and brackish water. Have the students research and list some examples of marine life that prefer the brackish water in estuaries to ocean water, and have them explain why. The estuaries of Virginia rivers flowing into the Chesapeake Bay are a good place to look.
3. Discuss osmosis with the students.

Sample assessment

- Assess the students' lab sheets for understanding.
- Have students write their own definition of *salinity*, and assess for understanding.

Follow-up/extension

- Challenge students to create a "rainbow" of layered waters by using different-colored water of various salinities. See the following Website for directions: http://www.lessonplanspage.com/ScienceOceanCurrents78.htm.
- Have the students repeat the water-layering experiment, but using two samples of the same ocean water at two different temperatures. Have them analyze how the differences in ocean water temperature in one location might affect the marine life that can live there.

Resources

- *BlueFrontier Oceans for Life.* National Geographic. http://www.nationalgeographic.com/seas/. Feature many classroom activities.
- *Bridge: Sea Grant Ocean Science Education Center.* Virginia Institute of Marin Science. http://www.vims.edu/bridge/. Offers many ocean-related resources.
- *Chesapeake Bay Program: America's Premier Watershed Restoration Partnership.* http://www.chesapeakebay.net/index.cfm. Offers information on estuaries and their marine life.
- *Ocean Planet: Interdisciplinary Marine Science Activities.* Smithsonian Institution. http://smithsonianeducation.org/educators/lesson_plans/ocean/main.html.
- *Science and Technology Focus — Oceanography.* Office of Naval Research. http://www.onr.navy.mil/focus/ocean/default.htm. Contains some great resources on oceanography and astronomy.
- *Windows to the Universe: Chesapeake Bay.* http://www.windows.ucar.edu/tour/link=/earth/Water/chesapeake.html.

Salinity

Name: _____ **Date:** _____

1. Describe the odor of each sample of water.

   Fresh water: _____

   Ocean water: _____

2. Find and record the volume of each sample of water.

   Fresh water: _____ ml Ocean water: _____ ml

3. Draw what you saw when you observed each drop under the magnifying glass or microscope.

   Fresh Water Ocean Water

4. Predict what you will see as the two drops of water evaporate.

   Fresh water: _____

   Ocean water: _____

5. Describe what you actually saw after each drop evaporated.

   Fresh water: _____

   Ocean water: _____